Space Weather Technical Forecast

Issued on Wednesday, 01 May 2024 at 13:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Further M-flares likely with a chance of X-flares through the period.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is at Moderate levels with a M9.4 flare peaking at 30/2346 UTC, and two further lower M-class flares at 30/1510 UTC and 30/1630 UTC, all originating from AR3654. There are currently six sunspot regions on the visible disc. AR3654 in the southwest continues to dominate the flare risk. This region continues to show significant complexity within its intermediate portion in recent imagery and a clear delta spot remaining visible despite the increasingly distorted viewing angle as it moves towards the western limb. Remaining sunspot regions are all significantly smaller and simpler by comparison.

A filament eruption beginning at 01/0600 UTC in the southwest disc close to AR3654 resulted in a notable CME signature in coronagraph imagery. Analysis of this event is ongoing, however, due to its far-west location on the disc, is unlikely to have an Earth-directed component.

Solar Wind / Geomagnetic Activity: Solar winds observed by ACE at L1 decreased from slightly elevated to background through the period, with a peak speed of 425km/s at 30/1611 UTC as ongoing weak CME influence eased. Density was variable, but predominantly above average at first, then declined to average or below average levels from around 01/0500 UTC. The Interplanetary Magnetic Field was initially weak, but saw a number of stepwise increases after the CME arrival, reaching a moderate peak of 13nT at 01/0644 UTC. The north-south component, Bz, initially weakly positive, saw erratic negative drops following the CME arrival, with a minimum of -10nT recorded, before rotating to a moderately positive direction from around 01/0130 UTC. Phi angle has been variable. Resultant Geomagnetic activity was Quiet to Active (Kp 1-4).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES18 was at background levels. High energy electron flux (greater than 2MeV) observed at GOES16 was at background to moderate levels. The associated 24-hour fluence was well below the Active threshold. Observed fluence at 01/0001UTC was 9.69e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate solar activity is likely to continue with further M-flares likely and a chance of isolated X-flares, principally from AR3654.

Solar Wind / Geomagnetic Activity: There is currently one CME that features in the forecast, associated with an eruption near centre disc approximately 29/0930 UTC. Modelling suggests the risk of a glancing blow from this feature sometime during day 3 (03 May). A notable CME that left the disc around 01/0600 UTC from the southwest disc is currently being analysed but is not expected to have an Earth-directed component.

Solar winds are currently at background levels (around 370km/s) with ongoing, but weak influence from a CME that arrived on 30 Apr. Effects should subside on day 1 (01 May), but a potential weak HSS connection may bring slightly enhanced wind speeds briefly into day 2 (02

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May). Conditions are then expected to gradually return towards background through days 2 and 3 (02-03 May). Further HSS influence may see another increase in wind speeds back to elevated levels later on day 3 into day 4 (03-04 May).

Geomagnetic activity is expected to be generally Quiet to Unsettled through the period, but with a chance of Active intervals at times due to weak CME influence and potential HSS arrivals and a very slight chance of G1/Minor storm intervals.

Energetic Particles / Solar Radiation: High energy proton flux is most likely to remain at background levels through this period. There is a chance for an S1/Minor Storm or greater event, should any proton-rich flares occur, primarily from AR3654, currently located in the western hemisphere.

High energy electron flux is expected to remain at background to moderate levels, with associated fluence expected to remain below the Active (1e8 integrated pfu) threshold throughout.

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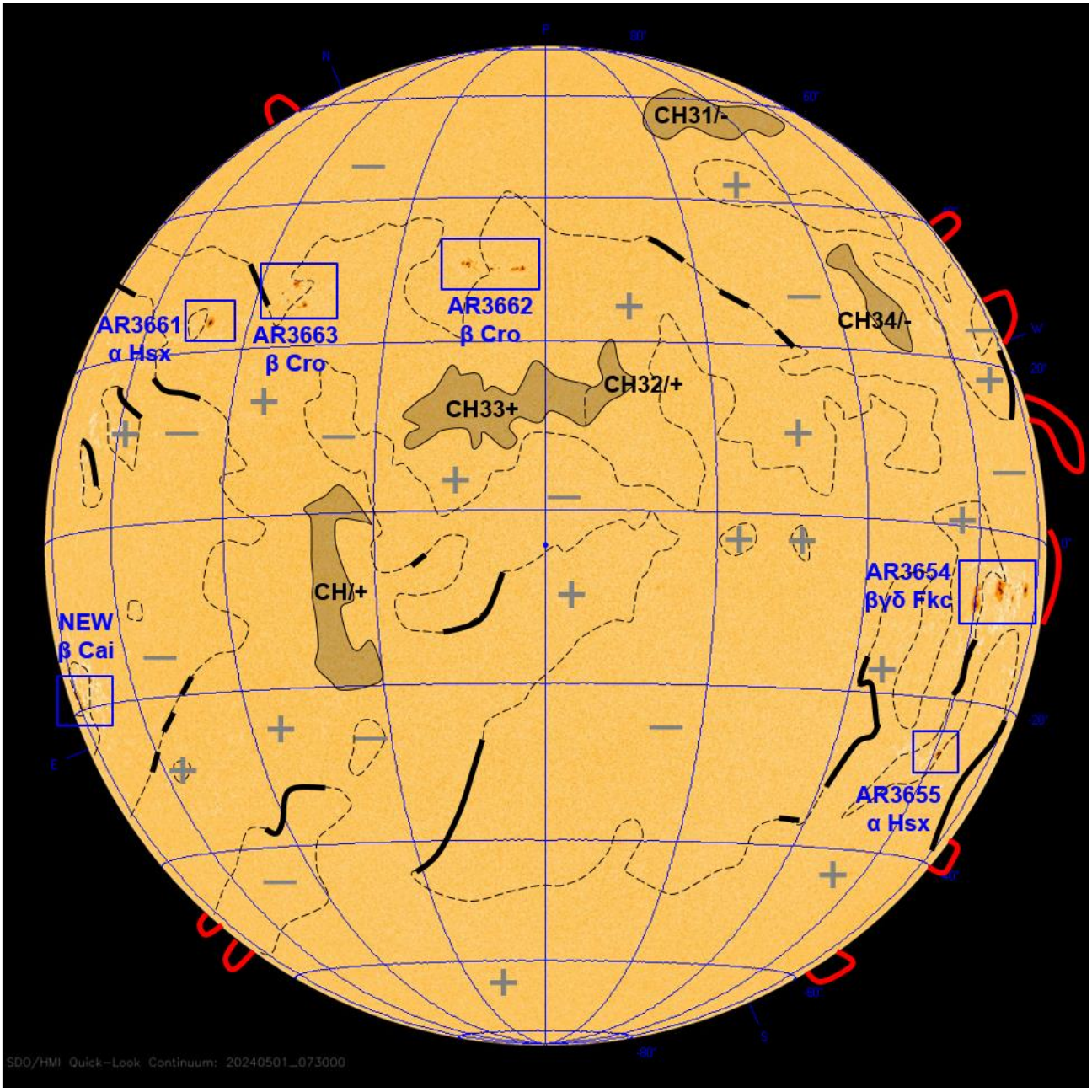
Figure 1. Solar Analysis Valid 01/0630 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

One CME currently features in the forecast period, associated with an eruption near centre disc approximately 29/0930 UTC. The CME was seen deflecting north and westwards in AIA-304 imagery. Modelling suggests the risk of a glancing blow from this feature sometime during day 3 (03 May). A filament eruption beginning at 01/0600 UTC in the southwest disc close to AR3654 resulted in a notable CME signature in coronagraph imagery. Analysis of this event is ongoing, however, due to its far-west location on the disc, is unlikely to have an Earth-directed component.

Solar winds are currently at background levels, around 370km/s, with ongoing CME influence from a CME that arrived on 30 Apr. Effects should continue to slowly ease on day 1 (01 May) followed by a potential connection from the recently re-numbered coronal hole CH34/-, perhaps bringing slightly elevated to elevated wind speeds briefly into early day 2 (02 May). Conditions are then expected to gradually return towards background through days 2 and 3 (02-03 May). CH32/+ and CH33/+ near centre disc in the northern hemisphere may see another increase in wind speeds towards elevated levels later on day 3 into day 4 (03-04 May), perhaps combining with CME influences to give minor enhancements.

Geomagnetic activity is expected to be generally Quiet to Unsettled through the period, but with a chance of Active intervals at times due to weak CME influence and potential HSS arrivals and a very slight chance of G1/Minor storm intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	10	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
29/2250	Partial	Plage	Centre-southern disc	450 km/s	03/2000 UTC	Low confidence glancing blow

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Radio Blackouts - X-Ray Flares:

There are currently six sunspot regions on the visible disc. AR3654 in the western disc continues to dominate the flare risk. Although there has been little recent change in appearance, the region continues to show significant complexity within its intermediate portion. A delta spot remains visible despite the increasingly distorted viewing angle as it moves towards the western limb. Remaining sunspot regions are all smaller and simpler in comparison, with a new, unnumbered region appearing on the southeast limb. Additional complexity is now evident increasing significant flare probabilities.

There are limited signals in far-side helioseismographs for any significant oncoming regions in the coming days, but some smaller returning regions are expected, including Ex-3633 that appears close to the western horizon based on magnetic looping evident in SDO/AIA 171 imagery. Overall, the significant flare risk should decrease into day 4 (04 May) as AR3654 rotates off the visible disc during day 3 (03 May). Overall, further M-flares are likely, with a chance of isolated X-flares, principally from AR3654.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	75	75	75	50
Very Active	R3 to R5 X Class	No	20	20	20	10

Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV) observed at GOES-18 has been at background levels and is most likely to remain that way through the period. There is a chance for an S1/Minor Storm or greater event however, should there be any large, proton-rich flares from AR3654 as it continues to rotate westwards, with the risk persisting into day 4 (04 May) despite the region rotating over the western limb.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	20	20	20	20
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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High Energy Electrons Event (≥ 2MeV):

High energy electron flux is at background levels. Combined minor CME and coronal hole influences through the period are likely to suppress electron flux to background to moderate levels throughout the period.

Overall, the 24 hour integrated electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold, with MOSWOC REFM output a good guidance at present.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 2: Latest GOES18 >2MeV Electron Flux (top) and MOSWOC REFM forecast and recurrence (below)

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